MARCH 11, 2011 JAPAN EARTHQUAKE AND TSUNAMI

Updated: June 23, 2011 at 20:00 UTC, 02:00 pm MDT

The 11 March 2011 magnitude 9.0 Honshu, Japan earthquake (38.322 N, 142.369 E, depth 32 km) generated a tsunami that was observed all over the Pacific region and caused tremendous devastation locally[*]. This is the fourth largest earthquake in the world and the largest in Japan since instrumental recordings began in 1900. The IOC/UNESCO reports that as of June 15, 2011, there are 15,429 deaths and 7,781 missing in Japan. This is the deadliest tsunami since the 2004 magnitude 9.1 Sumatra earthquake and tsunami caused nearly 230,000 deaths and $10 billion in damage. This is the most devastating earthquake to occur in Japan since the 1995 Kobe earthquake caused over 5,500 deaths and the deadliest tsunami since the 1993 Hokkaido earthquake generated a tsunami which was responsible for over 200 deaths.

MARCH 11, 2011 EYEWITNESS AND INSTRUMENTAL RECORDINGS

Preliminary field survey results indicate the highest runup height was 38 meters (no tide correction) in Iwate Prefecture (http://outreach.eri.u-tokyo.ac.jp/eqvolc/201103_tohoku/eng/). Runup is the difference between the elevation of maximum tsunami penetration (inundation line) and the sea level at the time of the tsunami. Tide gauge recordings in Japan range from 1 to 7 meters. Three meter waves were observed by eyewitnesses in the Kuril Islands, Russia. Two meter waves were observed at tide gauges in South America, Hawaii, and the west coast of the United States. The highest wave ever recorded by an ocean-bottom sensor was measured at 1.08 meters by DART® station 21418 located 450 nautical miles northeast of Tokyo. NGDC will continue to update the historic tsunami database as eyewitness and field survey reports are received.

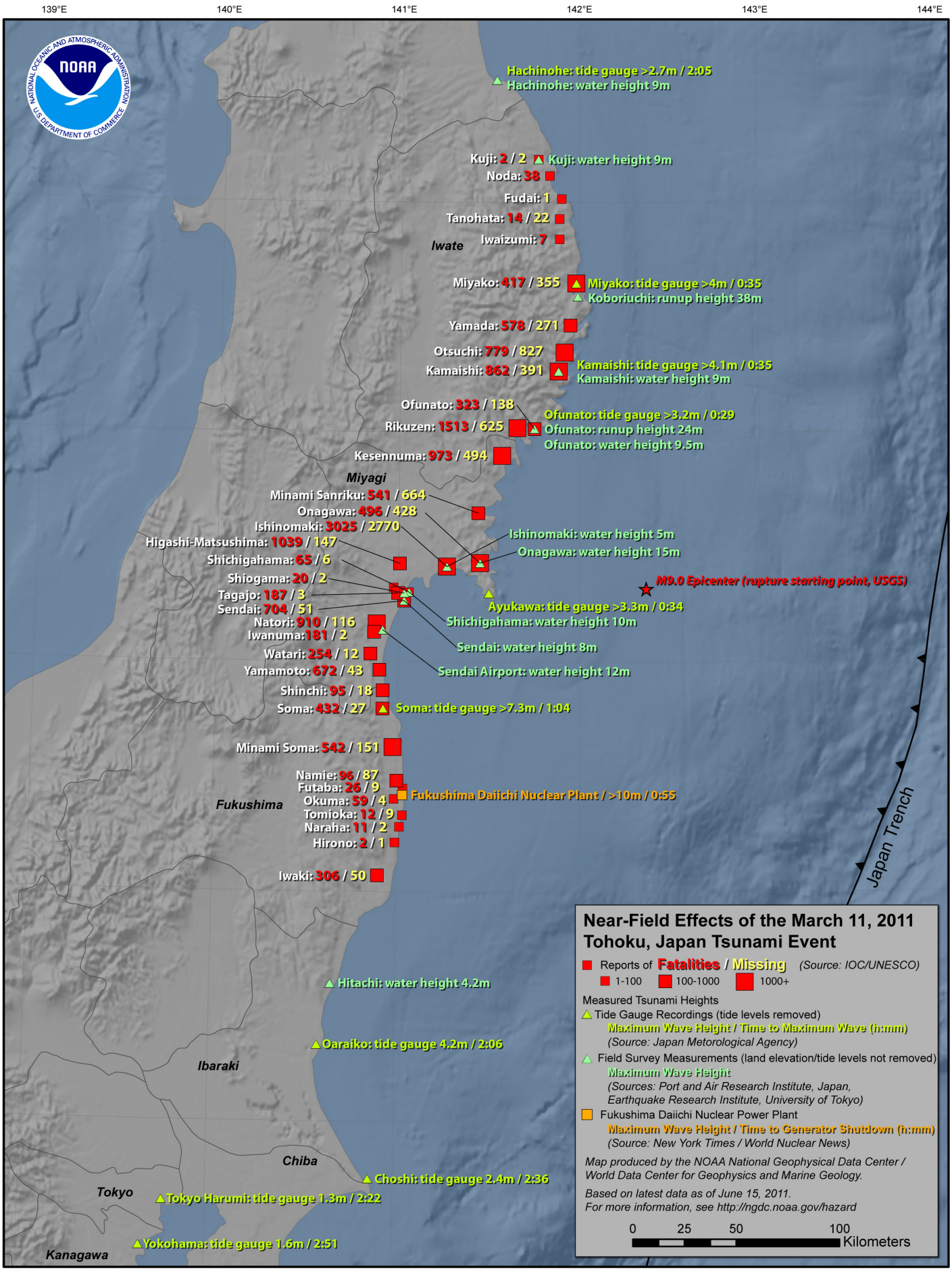
HISTORICAL EARTHQUAKES AND TSUNAMIS IN JAPAN

According to the NOAA National Geophysical Data Center / World Data Center for Marine Geology and Geophysics / (http://ngdc.noaa.gov/hazard) Global Historical Event databases, 2,108 tsunamis (validity ≥ 1[†]) have occurred in the world since 2000 B.C. and 279 (13%) of these tsunamis caused deaths. In the Japanese region, 306 tsunamis (validity ≥ 1[†]) have been observed since 684 A.D., and 76 (25%) of these events caused deaths. The majority of Japanese tsunamis were generated by earthquakes (87%), the remainder resulted from volcanic eruptions (5%) and unknown causes (8%). The most fatal Japanese earthquakes and tsunamis are listed below:

- 1293 Kamakura earthquake caused ***23,024 deaths*** and generated a small tsunami
- 1498 Enshunada Sea earthquake-generated tsunami caused ***31,000 deaths***
- 1586 Ise Bay earthquake and tsunami caused over ***8,000 deaths***
- 1771 Ryukyu Islands earthquake-generated tsunami caused over ***13,000 deaths***
- 1792 Mt. Unzen eruption generated a tsunami . The eruption and tsunami caused over ***15,000 deaths***
- 1847 Zenkoji earthquake caused ***12,000 deaths***
- 1855 Tokyo earthquake caused ***6,757 deaths*** and generated a small tsunami
- 1891 Mino-Owari earthquake caused ***7,273 deaths***
- 1896 Sanriku earthquake and tsunami caused over ***27,000 deaths***
- 1923 Sagami Gulf earthquake caused over ***99,000 deaths*** and generated a tsunami that caused over ***2,000 deaths***
- 1995 Kobe earthquake caused ***5,502 deaths*** and generated a small tsunami

[*]Data are collected from the US NOAA National Weather Service Tsunami Warning Centers, the US Geological Survey National Earthquake Information Center, the US NOAA National Data Buoy Center, IOC/UNESCO and news organizations. Refer to the NGDC event page for data and their sources (http://ngdc.noaa.gov/hazard/tsu_db.shtml).

[†]A validity score or confidence designation is assigned to each tsunami event ranging from -1 for erroneous entries to 4 for definite or confirmed tsunamis.


139°E
140°E
141°E
142°E
143°E
144°E
40°N
39°N
38°N
37°N
36°N
Hachinohe: tide gauge >2.7m / 2:05
Hachinohe: water height 9m
Kuji: 2 / 2
Kuji: water height 9m
Noda: 38
Fudai: 1
Tanohata: 14 / 22
Iwaizumi: 7
Iwate
Miyako: 417 / 355
Miyako: tide gauge >4m / 0:35
Koboriuchi: runup height 38m
Yamada: 578 / 271
Otsuchi: 779 / 827
Kamaishi: 862 / 391
Kamaishi: tide gauge >4.1m / 0:35
Kamaishi: water height 9m
Ofunato: 323 / 138
Rikuzen: 1513 / 625
Ofunato: tide gauge >3.2m / 0:29
Ofunato: runup height 24m
Ofunato: water height 9.5m
Kesennuma: 973 / 494
Miyagi
Minami Sanriku: 541 / 664
Onagawa: 496 / 428
Ishinomaki: 3025 / 2770
Ishinomaki: water height 5m
Higashi-Matsushima: 1039 / 147
Onagawa: water height 15m
Shichigahama: 65 / 6
M9.0 Epicenter (rupture starting point, USGS)
Shiogama: 20 / 2
Tagajo: 187 / 3
Sendai: 704 / 51
Ayukawa: tide gauge >3.3m / 0:34
Natori: 910 / 116
Iwanuma: 181 / 2
Shichigahama: water height 10m
Sendai: water height 8m
Watari: 254 / 12
Yamamoto: 672 / 43
Sendai Airport: water height 12m
Shinchi: 95 / 18
Soma: 432 / 27
Soma: tide gauge >7.3m / 1:04
Minami Soma: 542 / 151
Namie: 96 / 87
Futaba: 26 / 9
Fukushima Daiichi Nuclear Plant / >10m / 0:55
Okuma: 59 / 4
Fukushima
Tomioka: 12 / 9
Naraha: 11 / 2
Hirono: 2 / 1
Iwaki: 306 / 50
Japan Trench
Hitachi: water height 4.2m
Oaraiko: tide gauge 4.2m / 2:06
Ibaraki
Chiba
Choshi: tide gauge 2.4m / 2:36
Tokyo
Tokyo Harumi: tide gauge 1.3m / 2:22
Yokohama: tide gauge 1.6m / 2:51
Kanagawa
Near-Field Effects of the March 11, 2011 Tohoku, Japan Tsunami Event
Reports of Fatalities / Missing (Source: IOC/UNESCO)
1-100
100-1000
1000+
Measured Tsunami Heights
Tide Gauge Recordings (tide levels removed)
Maximum Wave Height / Time to Maximum Wave (h:mm)
(Source: Japan Meterological Agency)
Field Survey Measurements (land elevation/tide levels not removed)
Maximum Wave Height
(Sources: Port and Air Research Institute, Japan, Earthquake Research Institute, University of Tokyo)
Fukushima Daiichi Nuclear Power Plant
Maximum Wave Height / Time to Generator Shutdown (h:mm)
(Source: New York Times / World Nuclear News)
Map produced by the NOAA National Geophysical Data Center / World Data Center for Geophysics and Marine Geology.
Based on latest data as of June 15, 2011.
For more information, see http://ngdc.noaa.gov/hazard
0
25
50
100
Kilometers

March 11, 2011 Tsunami Event: Observed Water Heights and Computed Tsunami Travel Times